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ABSTRACT

Modality research is of major importance to the field of reading; it has directed attention to three factors: intersensory transfer, intersensory perceptual shifting, and modal preference. This paper provides a critical review of the most pertinent research relating each of these factors to reading achievement. No attempt is made to review studies which focus on auditory perception or visual perception alone. Rather the review is confined to those studies which explore various modal relationships, largely auditory versus visual. The review of literature is followed by a synthesis of basic conclusions to be drawn from the research, including its major weaknesses. The final section of the paper is devoted to recommendations for further research in the three areas. A citation bibliography is appended. (Author)

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Intersensory Transfer, Perceptual Shifting, Modal Preference, and Reading

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James L. Laffey
Director of ERIC/CRIER

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Foreword

ERIC/CRIER and IRA are concerned with several types of information analysis and their dissemination to audiences with specific professional needs. Among these is the producer of research—the research specialist, the college professor, the doctoral student. It is primarily to this audience that the present series is directed, although others may find it useful as well. Therefore, the focus will rest clearly on the *extension* of research and development activities: “Where do we go?” Our intent is not to provide a series of exhaustive reviews of literature. Nor do we intend to publish definitive statements which will meet with unanimous approval. Rather, we solicit and present the thoughtful recommendations of those researchers whose experience and expertise have led them to firm and well-considered positions on problems in reading research.

The purpose of this series of publications is to strengthen the research which is produced in reading education. We believe that the series will contribute helpful perspectives in the research literature and stimulating suggestions to those who perform research in reading and related fields.

Richard A. Earle
Series Editor

Introduction

Providing each child with the most effective reading instruction possible remains the ultimate goal of professionals in the field of reading. Individual needs and abilities should be the foundation of instruction. In order to allow for pupil differences, we need to know more about perceptual and cognitive functions and their relationships to reading achievement. Researchers investigating these functions must consider the contributions of the various sensory channels or learning modes, as they relate to one another and to reading achievement.

Modality research is of major importance to the field of reading; it has directed attention to three factors: intersensory transfer, intersensory perceptual shifting, and modal preference. This paper provides a critical review of the most pertinent research relating each of these factors to reading achievement. No attempt is made to review studies which focus on auditory perception or visual perception alone. Rather, the review is confined to those studies which explore various modal relationships—largely auditory *versus* visual. This distinction is continued throughout the paper.

The review of literature is followed by a synthesis of basic conclusions to be drawn from the research, including its major weaknesses. The final section of the paper is devoted to recommendations for further research in the three areas. A citation bibliography is appended.

Certain terms which will be used throughout this review need to be defined. The terms are arranged here as they appear within the paper.

Mode	<i>A sensory channel through which sensations are transmitted and received (e.g., vision, hearing, touch, and muscular movement)</i>
Mediational channel	
Sensory channel	

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Intersensory Transfer	<i>Translation of information from the terms of one</i>
Intersensory Integration	<i>sensory channel to those of another, enabling</i>
Cross-modal transfer	<i>information to become analogous through</i> <i>association</i>
Auditory-Visual Transfer	<i>Intersensory transfer between the auditory and</i>
Auditory-Visual Integration	<i>visual channels</i>
Intersensory Perceptual Shifting	<i>The shifting of attention from one mode</i> <i>to another</i>
Intersensory Perceptual Reaction Time	<i>Measure of time required to effect</i> <i>intersensory perceptual shifting</i>
Modal Preference	<i>That mode preferred by an individual or by the</i>
Optimum Learning Mode	<i>majority of a group, as indicated by preference</i> <i>ranking or task performance</i>
Ipsimodal Stimuli	<i>Those presented in different forms of the same mode</i> <i>(e.g., pictures and written words)</i>

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Intersensory transfer and reading achievement

The interrelatedness of the auditory and visual senses is important to a discussion of the relationship existing between the auditory and visual modalities in the reading process, Strang (1968b) states:

To grasp the meaning of an unfamiliar word, unskilled or beginning readers need to say it or form the spoken word with their lips. Even fluent readers may evoke auditory and motor images of which they are scarcely aware and may resort to obvious vocalization when they meet an unfamiliar word (p. 132).

She also expresses the belief that a highly proficient reader may make a direct association between the printed symbols and the meaning which they represent. This belief is in agreement with Huey (1908) who stated: "Purely visual reading is quite possible, theoretically . . ." (p. 117). Purely visual reading would appear to be possible since deaf people who have never learned a language have learned to read. However, Strang (1968b) is probably correct in the following observation:

For the large majority of children, proficiency in visual and auditory perception and the integration of these two modalities are essential to achievement in reading (p. 139).

Strang (1968a) also indicates that auditory-visual integration is part of the sequence in learning to read. She states:

Skillful teaching is sequential. It progresses from auditory and visual perception, discrimination, and memory to the integration of auditory with visual symbols, to simple categorization and concept formation (pp. 50-51).

The importance of integration of the auditory and visual modes is recognized by Eisenberg (1966), as indicated by the following:

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Defects in seeing and hearing impede information transmission over the primary channels whose integration is required for reading (p. 13).

The printed symbols which are used to convey messages in written form are actually representations of the auditory form of the message. That is to say, when someone wishes to convey information in printed form, the printed symbols represent the words which the encoder mentally pronounces or employs in shaping the message. The decoder appears to transform the printed symbols back into the same mental pronunciations of speech which the encoder employed. Reading, then, does not negate the need for the spoken form of messages. Rather, it is an additional step which provides certain advantages over oral communication—permanence, encoder not required to be present, etc. The mental equivalent of the spoken form of the message is still involved in the communication process; both encoder and decoder still “say” the message or pronounce the words of the message mentally.

Evidence of this transformation in printed communication is presented by Huey (1908) and Edfeldt (1960). Huey (1908) instructed his subjects to read in various ways—as they normally read, aloud, with lip movements, and saying the words to themselves. The times required to read the pages were carefully recorded and compared. He found the following:

Motorizing with lips closed at the “comfortable” speed gave nearly the same average rate as when the reading was by the reader’s “own method,” 5.29 words per second for the former and 5.35 for the latter, for twenty readers tested. Of twenty post-graduate students who were tested, but two or three used lip-movement when reading “as they liked.” Many of the others who “motorized” said that the pronunciation was “up in the head,” and it usually seemed to be without any very noticeable movements of the articulatory apparatus (pp. 119-120).

Electromyographic methods were employed by Edfeldt (1960) to identify movements of the speech muscles during silent reading. He concluded that silent speech accompanies the reading of all persons, though reading ability, readability, and legibility determine the degree to which inner speech is evidenced by movement in the speech muscles.

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Birch and Belmont (1964) conducted an experiment in intersensory transfer which employed analogous stimuli in a cross-modal situation. They prepared an auditory-temporal to visual-spatial pattern test consisting of three examples and 10 test items. The examiner tapped the temporal patterns on a table top with a pencil, with the subject choosing the corresponding visual pattern from among three spatial dot patterns on a response sheet. The test was administered to a sample of 150 retarded readers and 50 good readers, 9 and 10 years of age, from Aberdeen, Scotland. The investigators found that the good readers made significantly fewer incorrect responses than did the poor readers. When the good readers were divided into two equal high and low groups on the basis of performance on their auditory-visual integration test, highly significant differences in mean reading scores were found. This also held true for the retarded readers. They concluded that one of the contributing factors of reading retardation was the poor development of intersensory transfer.

Weaknesses of the study which later experiments attempted to correct include: 1) the low ceiling of the test; 2) lack of precision in the method of presentation of the auditory stimuli; 3) visibility of the tapping out of auditory stimuli, possibly making the task ipsimodal rather than cross-modal, or at best, a combination of the two; and 4) no consideration of the visual-to-auditory aspect of reading.

Using 220 children in grades kindergarten through six, Birch and Belmont (1965) studied the development of auditory-visual transfer in relation to reading achievement and IQ. The Birch and Belmont test, Otis Quick Scoring Tests of Mental Ability, and Stanford Achievement Tests were administered to all subjects. The experimenters found that the improvement of auditory-visual transfer skill was steady and continued until the fifth grade. The greatest development occurred between kindergarten and second grade. Auditory-visual transfer performance was significantly related to IQ, except in kindergarten and grade six. However, the two variables did not appear to be synonymous. Correlations between the auditory-visual pattern test and the Stanford Achievement Tests were significant at the first and second grade levels only, indicating the decline of the initial importance of auditory-visual transfer after the early grades.

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These findings, in terms of grade levels, may not be applicable to the general population because the sample was not representative as indicated by their mean IQ ($X = 120$). In addition, the test of auditory-visual integration did not have enough ceiling to differentiate between subjects at the higher grade levels. The manner of presentation of the auditory stimuli (pencil tapping on table top) is also questioned for the same reasons given when reporting the 1964 study.

In a study reported first by Kahn (1965) and then by Kahn and Birch (1968), the interrelationships among auditory-visual transfer, chronological age, intelligence, and reading achievement were studied. The number of items on the Birch and Belmont test was increased from 10 to 20 to provide greater ceiling and reliability; the test was administered individually to 350 boys randomly selected from grades two through six. Product-moment correlation coefficients were computed between the auditory-visual transfer scores and chronological age, Metropolitan Word Knowledge and Reading Comprehension scores, Lorge-Thorndike Verbal and Nonverbal IQ's, and the wisc Digit Span subtest scores. Significant correlations ranging from .37 to .57 were reported between the intersensory transfer test and vocabulary and comprehension scores. Chronological age and auditory-visual transfer were also positively related with an overall coefficient of .51. When IQ was held constant, auditory-visual transfer and word knowledge were still significantly related; but the transfer and comprehension coefficients did not retain their significance. Tests of auditory rhythm, auditory memory, and visual discrimination could not account for the significant relationship between auditory-visual transfer ability and reading achievement.

The purpose of Sterritt and Rudnick's (1966) experiment was to determine if Birch and Belmont's test really measures auditory-temporal to visual-spatial transfer or whether it measures temporal-spatial transfer within the visual mode. The 36 fourth grade boys making up the sample were given the Birch and Belmont test and two variations of it. In the first variation (A), the temporal stimuli were given by tape; in the second (V), stimuli were presented by a GE-47 stimulus lamp with a red jewel cover. The A-test variation made a significant contribution to the prediction of reading achievement in-

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dependently of mental age; the Birch and Belmont test and the V-test variation did not. This led the investigators to the conclusion that the significant relationship of Birch and Belmont's test to reading achievement was entirely attributable to general intelligence. However, since their A-test variation did predict reading achievement independently of mental age, they concluded that auditory-visual transfer is a significant independent predictor of reading achievement.

Rudnick, Sterritt, and Flax (1967) repeated the Sterritt and Rudnick (1966) study using a sample of 36 third grade boys. The perceptual tests did not produce a greater range of scores for the third graders than they had for the fourth graders, as had been expected. The mental age and auditory-visual test scores, though significant, did not predict reading achievement as well for the third grade subjects as for the fourth grade subjects. The visual-visual integration test accounted for a greater percentage of the reading score variance than the auditory-visual integration test. The opposite of this was reported in the study using fourth graders. The investigators concluded that visual perceptual abilities appear to decrease in importance while auditory-visual transfer ability becomes more important with increase in grade level beginning in grade three. As reported above, Birch and Belmont (1965) concluded that the relative importance of transfer skill declined with increase in grade level.

The same criticism is applicable to both of the last studies—the samples ranked well above average in IQ. Therefore, the grade levels reported in the conclusions may be misleading.

Further expansion of intersensory transfer investigation was accomplished by Muehl and Kremenak (1966). They considered all possible combinations of intersensory and intrasensory transfer involving the visual and auditory channels and their relationship to reading achievement. These included: 1) auditory-to-auditory (A-A); 2) visual-to-visual (V-V); 3) auditory-to-visual (A-V); and 4) visual-to-auditory (V-A). The tests employed were similar to the Birch and Belmont test, but the visual stimuli consisted of dots and dashes and the auditory stimuli were presented with a telegraph key hidden behind a screen. The subjects did not select the correct pattern from

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among three, as in the Birch and Belmont test, but signified whether the two stimuli were the same or different.

The four pattern-matching tests were administered to 119 first graders in September. The Reading subtest of the Metropolitan Achievement Test, Primary Battery, was given in May and served as the criterion for reading achievement. The V-V test proved to be the easiest task and the A-A was the most difficult. The V-A and A-V task difficulty levels fell between the two extremes, with the latter being slightly more difficult. Comparing the top 22 percent and the bottom 23 percent on the Reading subtest of the Metropolitan, the investigators found the intersensory transfer abilities, V-A and A-V, to be significant independent predictors of first grade reading achievement (.39 and .52, respectively). V-A and A-V performances were also significantly related to the ability to name letters on the letter naming subtest of the Harrison-Stroud Reading Readiness Profiles. Letter naming ability proved to be the best single predictor of reading achievement.

A second study which considered both A-V and V-A transfer ability was conducted by Beery (1967). His samples were composed of two groups of 15 students from 8 to 13 years of age, equated for intelligence, sex, and age, but differing significantly in reading achievement. Three perceptual tests were administered: 1) the Birch and Belmont test (A-V); 2) a longer version of the Birch and Belmont test; and 3) the converse of the Birch and Belmont test (V-A). All three of the perceptual transfer tests were significant predictors of reading achievement. Each showed the retarded readers to be inferior to the normal readers in intersensory transfer skills. Since intelligence was controlled, this study demonstrated once again that intersensory integration ability is an independent predictor of achievement in reading. The study was strengthened by the use of an individual rather than a group test of intelligence.

Using a modified version of the Birch and Belmont test (20 items instead of 10, with an extra foil for each item) and a tactual-to-visual integration test developed by Buchner (1964), Ford (1967) investigated the relation of intelligence and reading achievement to auditory-visual (A-V) and tactual-visual (T-V) transfer ability. His

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sample consisted of 121 fourth grade boys. Significant correlations were obtained between auditory-visual transfer scores and reading achievement levels, but only when intelligence (as measured by the Henmon-Nelson, Revised Edition) was not controlled. Possibly, Ford did not find auditory-visual transfer to be significantly related to reading achievement independently of intelligence because a group test of intelligence was used instead of an individual test. T-V and A-V transfer skills were not highly correlated, nor were T-V transfer ability and reading achievement.

Ten perceptual tests involving sequential spatial and temporal patterns were administered by Sterritt, Martin, and Rudnick (1969) to forty third grade children. One of the 10 tests was the modified Birch and Belmont test described in a previous study (Sterritt and Rudnick, 1966). The other nine tests used similar methods of presenting the sequential patterns except that the subjects were presented with only two patterns and asked whether they were alike or different. Group tests of intelligence and reading achievement were also given. Only two of the perceptual tests (visual temporal-auditory temporal and auditory temporal-auditory temporal) were significant predictors of reading achievement over a seven to nine month period. The Birch and Belmont test did not correlate significantly with reading achievement. The analysis of the data in this study was considered by the investigators as being incomplete at the time of reporting.

A modified Birch and Belmont test was also employed by Jones (1970) to determine the relationships between auditory-visual transfer and two measures of reading achievement—sight vocabulary and reading comprehension—for a group of 90 third grade children. The number of items was extended to 20 and the auditory-temporal patterns were presented by tape to insure the absence of visual cues. Presentation by tape also served as a control for pattern variations due to human error. In addition to the above modifications, the test was administered in group settings rather than individually. All of the visual-spatial patterns were typed on a single response sheet 14 inches in length using the period key on a primary typewriter. A reliability coefficient of .88 was obtained using the Spearman-Brown Prophecy

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Formula and 51 third grade subjects selected from the same population base as the sample. Intersensory transfer ability correlated significantly ($p < .001$) with both sight vocabulary and reading comprehension, with correlations of .44 and .38 respectively. With the effects of intelligence controlled, intersensory transfer remained a significant ($p < .05$) predictor of sight vocabulary but not of reading comprehension.

Intersensory perceptual shifting and reading achievement

A second area of research concerned with the effect of the interrelatedness of the auditory and visual modes upon reading achievement is intersensory perceptual shifting. Intersensory transfer, as discussed in the previous section, is concerned with the association of analogous information received through the auditory and visual channels. Intersensory perceptual shifting, on the other hand, involves the ability to transfer attention rapidly from one modal source of input to another.

A study was conducted by Raab, Deutsch, and Friedman (1960) to determine if reading achievement and speed of intersensory shifting are significantly related. Twenty-four fourth and fifth grade children were divided into two groups on the basis of reading achievement. The groups were comparable in age but not in IQ. A red light, a low tone, and a high tone were used as stimuli and presented in a quasi-random sequence using an apparatus described by Sutton, Hakerem, Zubin, and Portnoy (1961). Each subject was instructed to raise his index finger from a telegraph key as quickly as possible each time a stimulus was presented. A record was made of the reaction time. No significant differences were found between good and poor readers in response time to stimuli in ipsimodal shifts. However, poor readers demonstrated significantly greater difficulty than good readers in reaction time to shifts of a cross-modal nature. The researchers concluded that speed of intersensory perceptual shifting and reading achievement are closely related. Speed of cross-modal shifting and IQ were not significantly related.

A study very similar to this one was conducted by Katz and Deutsch (1963). The major differences between the studies were: 1) Negro

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boys from the first, third, and fifth grades made up the sample; 2) a green light was added to give two visual stimuli; and 3) the response involved lifting a finger from a depressed button. The experimenters found significant differences in response time to cross-modal shifts between good and poor readers for all ages considered. This is in agreement with the findings of Raab *et al.* (1960).

Using a total of 120 subjects with an equal number randomly selected from grades two, four, and six, Hurd (1967) and Busby and Hurd (1968) duplicated Katz and Deutsch's (1963) study. An equal number of males and females were employed. A significant relationship was not found to exist between speed of cross-modal perceptual shifting and reading achievement. Hurd concluded that the difference in findings between his study and Raab, *et al.* (1960) and Katz and Deutsch (1963) might be attributable to the difference in experimental design, since he used a random sample rather than extreme groups.

A random sample was also employed in the study reported above by Jones (1970). The effect of intersensory perceptual shifting on reaction time was found to be inversely related to size of sight vocabulary. Subjects whose reaction times were affected the least by unexpected shifts in the mode of stimulus presentation tended to have the larger sight vocabularies. The significance ($p < .05$) of this relationship was relatively unaffected when the effects of intelligence were controlled. The correlation between intersensory perceptual shifting and reading comprehension was not significant with or without the effects of intelligence considered.

Modal preference and reading achievement

Previous summaries of modal preference research. Research concerned with modal preference began in the latter part of the nineteenth century and has been consistently carried on until the present. The general purpose of much of this research has been to compare listening and reading as input channels for the comprehension of analogous verbal and printed materials. Most of the modal comparison studies conducted prior to 1970 are summarized in at least one of the following compendia: Henmon (1912), Day and Beach

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(1950), McGeoch and Irion (1952), Witty and Sizemore (1958, 1959a, 1959b), and Jones (1970).

Henmon (1912) concluded that the findings of the available research comparing the different modes of learning were conflicting. He felt the conflicting findings were due to the experimenters' inability to determine and control for different imagery types.

More specific conclusions were drawn by Day and Beach (1950) in their survey of modal comparison studies. They summarized briefly the individual findings of 34 investigations comparing the auditory and visual modes as mediational channels. The studies were grouped on the basis of type of material presented with nonsense syllables, digits, discrete words, meaningful prose, and advertising copy serving as the five classifications of material. The authors stated that the major portion of the research indicated the following:

1. A combined presentation produces greater comprehension.
2. An oral presentation is more efficient for presenting meaningful, familiar material, while a visual presentation is best for meaningless, unfamiliar material.
3. Preference for the visual mode increases proportionately with the intelligence level of the receiver.
4. Preference for the visual mode increases proportionately with the reading ability of the receiver.
5. The auditory mode is preferred by six year olds, with a gradual transition evidenced until, by the age of 16, the visual mode is possibly superior.
6. An increase in the difficulty level of material results in a parallel increase in preference for the visual mode.
7. The visual presentation is superior for immediate recall; the auditory presentation, for delayed recall.
8. As the interval between presentation and recall is lengthened, the visual presentation becomes relatively less efficient.
9. The visual presentation is strengthened by the fact that any part of it can be referred to again for purposes of rereading. If the factor of referability is controlled, the relative efficiency of the visual presentation is diminished.
10. When the material to be learned is organized and related, the visual mode is superior.

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11. Material is easier to learn through the visual channel but better retained when presented via the auditory channel.

Individual differences appear to account for many of the conflicting reports of modality research. McGeoch and Irion (1952) believed these differences to be attributable to four major variables. The first of these factors was identified as *practice*. By practice the authors were referring to experience gained through the usage of a particular mode or type of stimulation. The authors listed *chronological age* as the second variable and stressed the necessary correlation between age and practice. In addition, they concluded that auditory presentations are superior to visual presentations for young children, but that this superiority diminishes with increase in age. This is very similar to the fifth conclusion drawn by Day and Beach (1950). The third factor given was *type of material to be learned*. The mode of presentation was seen as being less important when the learning task involved meaningful discourse than when disconnected materials were employed.

Mode of apprehension was named as the fourth variable. The authors stated that, although the mode of stimulation may be manipulated, the way each individual translates the information for cognition cannot be satisfactorily controlled. In essence, they propose that the intricate nature of the cognitive processes allows humans to translate "... the material into other terms than those in which it is presented ..." so readily "... that mode of stimulation may be unimportant, except in cases of very strong habituation to a particular mode" (p. 482). This suggests that cognitive style, which would involve Henmon's concept of imagery types, is of much greater importance than mode of presentation. The passage also states that some people have developed such a strong preference for a mode that their learning is seriously hampered when information is presented via any other channel.

In a serial review, Witty and Sizemore (1958, 1959a, 1959b) summarized most of the known research comparing oral and visual presentations. The more relevant conclusions reached by these authors include these:

1. Listening appears to be superior to reading in the early years of childhood.

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2. Reading seems to be more effective for adults when the materials require careful or critical analysis.
3. Groups and individuals usually demonstrate high correlations in their ability to learn through different sensory channels.
4. The tasks and the methods of employment and evaluation are significant independent variables.
5. Amount of experience with a particular form of stimulation is a determiner of success in learning.
6. The mode of presentation employed has very little effect on retention.
7. Administering a test in oral or written form produces very little difference in learning.
8. The auditory channel is superior to the visual channel when advertising materials are used.
9. Since a superior mode of presentation cannot be demonstrated except when special factors are operating (e.g., type of material, method of presentation, and experience and interests of the subjects), further modal comparison studies searching for a superior channel of presentation should be discontinued.

The last statement means that there is no generally superior mode. However, experimentation which deals with the variables involved in superior learning through a selected channel should be encouraged.

Individual modal preference as a factor in learning to read. There are many studies of modal preference to be found in these reviews. However, the purpose of most of them was the comparison of listening and reading as input channels for the comprehension of verbal and printed materials, or the learning of lists of words or nonsense syllables by groups. In these studies, differences were seen less as a researchable variable than as an annoying source of conflicting findings. Consequently, few studies have attempted to ascertain the modal preference of each subject and to determine whether the possession of such preference is a factor in learning to read.

Bateman (1968) sought to explore the relative effectiveness of visual and auditory approaches in beginning reading instruction. The sample consisted of 182 children in eight kindergarten classes. All of the classes received the Detroit Group Intelligence Scale and the Metro-

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politan Reading Readiness Test. The Illinois Test of Psycholinguistic Abilities (ITPA) was administered to four of the classes in order to divide them into auditory and visual preference groups. In the first grade, half of the auditory subjects were taught with an auditory method and the other half with a visual method. The same procedure was followed for the two visual classes which did not receive the ITPA. The visual method employed Scott, Foresman New Basic Readers, and the auditory method used Lippincott Basic Reading Series. Analysis of variance was used in the statistical treatment.

The auditory method produced superior reading and spelling achievement when compared with the visual method. The subjects labeled as auditory learners made significantly greater gains than did the subjects labeled as visual learners. No significant interaction between modal preference and instructional method was found.

However, two major weaknesses make the results of this study suspect. First, the Scott, Foresman and Lippincott materials used in the study are not distinctly visual or auditory in nature. Second, many of the children in the visual group actually scored higher on the auditory memory subtest of the ITPA than on the visual memory subtest of that same test—up to nine months. The probability is small that 50 percent of all incoming first graders prefer the visual mode and 50 percent prefer the auditory mode, but this is what the researcher assumed when assigning subjects to auditory and visual learning groups.

In another experiment employing different modes of presentation, Robinson (1968) classified 448 first grade pupils as either high visual-high auditory, low visual-low auditory, high visual-low auditory, or low visual-high auditory on the basis of their performance on three visual discrimination tests and Wepman's auditory discrimination test. Sight (basal reader) and phonic (Hay-Wingo) approaches were used. No significant differences were found between pupils in the high visual-high auditory, high visual-low auditory, or low visual-low auditory groups in the reading sections of the Metropolitan Achievement Tests and the Gray Oral Reading Test. Subjects in the low visual-high auditory group taught by the phonic method demonstrated greater silent reading achievement at the end of first grade.

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This study appears well planned and executed; the only apparent weakness lies in the classification of the basal reading program as a strictly sight approach.

A part of the study by Jones (1970) examined the relationships among modal preference and two measures of reading achievement, using 90 third grade pupils. Auditory and visual labeling tasks were constructed which required the subjects to learn strange auditory labels (using nonsense syllables) and strange visual labels (using McKee's alphabet) for pictures of concrete objects. The direction and extent of modal preference was obtained by subtracting the score on the visual task from the score on the auditory task. The modal preference score did not correlate significantly with size of sight vocabulary or reading comprehension as measured by the Metropolitan Reading Test. The part of the study dealing with modal preference was weak, however, due to strong ceiling effect of the modal preference test. Perfect scores were recorded by 25 percent of the subjects on the auditory labeling test and 22 percent on the visual labeling test. In addition, the relationship of the degree of modal preference to reading achievement was not examined separately from the direction, *i.e.* auditory or visual, of the preference. Subjects who exhibit very strong modal preference, regardless of the nature of that preference, might still evidence poorer reading achievement.

The primary purpose of Bruinink's (1968) dissertation was to determine whether subjects who show a preference for either the auditory or the visual mode also show a preference for certain methods of learning unknown words. From the second and third grades, 105 Negro boys were administered a battery of six auditory and six visual perception tests. These tests were used to select 20 auditory learners and 20 visual learners. An attempt was then made to teach each subject to recognize 15 unknown words, using a "look-say" approach, and 15 unknown words, using a phonic approach. The words were taught in two separate lessons, each 23 minutes long. Immediate learning and delayed recall (after one week) were tested. Analysis of variance was employed to analyze the scores of the two preference groups. Neither of the groups demonstrated a preference for either method of teaching new words. A serious limitation of this study is

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the misclassification and employment of the Birch and Belmont test as one of the auditory perceptual tasks, since it involves visual perception and intersensory association in addition to auditory perception.

The decoding and association subtests of the Illinois Test of Psycholinguistic Abilities were used by Cripe (1966) to find 18 first graders who preferred the auditory mode and 18 first graders who preferred the visual mode. The subjects were administered tasks involving auditory and visual stimuli, both linguistic and nonlinguistic in nature. The two groups did not differ significantly in the rate at which they learned the tasks. Cripe concluded that either the Illinois Test of Psycholinguistic Abilities fails to measure modal preference, or the test measures extremely subtle degrees of preference.

In a study by de Hirsch, Jansky, and Langford (1966), 53 kindergarten children were given four tests of auditory perception (Imitation of Tapped Patterns, Auditory Discrimination, Language Comprehension, and the Gates Rhyming Test) and four tests of visual perception (Bender Visual Motor Gestalt, Horst, Gates Matching, and Word Recognition tests). Ten of the 53 subjects demonstrated a strong modal preference; seven performed significantly better on the auditory tests than on the visual; three performed significantly better on the visual tests than on the auditory. The three subjects preferring the visual mode and five of the subjects preferring the auditory mode passed all of the reading tests administered to them at the end of the second grade. The other two subjects who preferred the auditory mode failed all of the reading tests. No valid conclusions can be drawn from these results because the study was not controlled for different methodologies or teachers.

The New York University Modality Test (1968) was used by Ringler, Smith, and Cullinan (1971) to classify the learning preferences (auditory, visual, kinesthetic, or no preference) of 128 first-grade children. Thirty of the children demonstrated an auditory preference; 33 a visual preference; 28 a kinesthetic preference; 37 had no preference. The subjects within each modality group were randomly assigned to one of four experimental treatments or to a control group. The experimental groups were labeled auditory, visual, kinesthetic, and

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combination. The learning task for each of the experimental groups consisted of a list of 50 vocabulary words identified as part of the children's speaking vocabulary, but not formally taught in the classroom. The subjects in the experimental groups received seven and one-half hours of small-group instruction, including differentiated presentation of the 50 words and oral reading of sentences and paragraphs containing the words. The control group did not receive any instruction involving the list of words. All subjects continued to receive developmental reading instruction using the *Bank Street Readers*. A criterion test consisting of the vocabulary list of 50 words plus an additional 150 words which served as distractors was used as the pretest and post-test measure of vocabulary development.

Statistical analysis yielded the following results:

1. The experimental groups made significantly greater gains than did the control group, but did not differ significantly from each other.
2. No significant differences were found among modality preference groups when treatment groups were not considered.
3. Pupils who were taught using their preferred mode did not make significantly greater gains than those pupils who received instruction through some mode other than their preferred one.

The purpose of Bursuk's experiment (1971) was to determine if sensory mode of lesson presentation was a factor in the improvement of reading comprehension of adolescent retarded readers. A group of 132 tenth grade students of average intelligence whose reading levels were one or more years below grade level were administered the Sequential Tests of Educational Progress (STEP), Reading Test, Form 2A and Listening Test, Form 2A. The results of these two tests were used to classify students as either auditory learners, visual learners, or learners with no sensory preference. After identification, 30 pupils were randomly selected from each classification. Thus, the final sample consisted of 30 auditory learners, 30 visual learners, and 30 learners with no preference. In each of the three groups, 15 students were assigned to a combined aural-visual approach, and an equal number was assigned to a predominantly visual approach.

The groups met for 45 minutes of reading instruction three times a

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week for a semester. The group receiving the combined aural-visual treatment worked on comprehension through listening for two sessions each week and through reading for one session each week. The group receiving the visual treatment worked on comprehension through reading lessons only.

The California Reading Test, Advanced Level, Form X was used to determine the amount of gain in reading comprehension. Using the .05 level of significance, the combined aural-visual approach proved to be more effective than the visual approach in improving the reading comprehension of the subjects. In addition, a significant interaction was found between the mode of lesson presentation and the modal preference of the learners. Auditory learners and learners with no modal preference made significantly greater improvement in reading comprehension than did the visual learners when the combined aural-visual approach was used. When the visual approach was used, the gains of the visual learners were significantly greater than those of either the auditory learners or learners with no preference.

Bimodal versus monomodal as the superior form of presentation of verbal material. One of the most controversial issues in the field of communications today concerns the relative value of presenting redundant verbal material through one channel (audio or print) as opposed to several channels (audio and print). According to Day and Beach (1950), earlier research supported the claim that a bimodal presentation produces more learning than a monomodal presentation. Hartman (1961) concluded from a series of experiments that, "Redundant information simultaneously presented by the audio and print channels is more effective in producing learning than is the same information in either channel alone" (p. 42). However, Severin (1967) predicted that, "Multichannel communications which combine words in two channels (words aurally and visually in print) will not result in significantly greater gain than single channel communications since the added channel does not provide additional cues" (p. 243).

The cue summation theory predicts that discriminative learning is increased as additional cues or stimuli are provided. The relevance of this theory to the present argument depends on the interpretation of

what constitutes "additional cues or stimuli."

When an identical message is presented simultaneously through the audio and print channels, the information is said to be *redundant*. Apparently Severin (1967) did not regard redundant information to be "additional cues," even when presented through a second channel. He wrote, "If cue summation is applicable in this situation, it is difficult to see why a combination of the same cues (total redundancy in audio and print) should result in a gain, since the second channel is not adding related cues" (p. 238). However, Hartman (1961) had previously expressed the belief that "According to the cue summation theory, learning will increase with the addition of channels" (p. 28). Severin and Hartman interpret "additional cues" differently; consequently both are able to employ the same theory to support their respective positions.

The Filter Theory was generated by Broadbent (1958) to explain how the central nervous system processes sensory information. Broadbent theorized that when two oral messages arrive simultaneously, only one message at a time may be processed by the higher level mechanisms of the nervous system. The other message is stored for a short time until the processing "channel is cleared" or until fading occurs with a subsequent loss of the message.

The theory was employed by Van Mondfrans and Travers (1964) as an argument against the proposed superiority of simultaneous multichannel presentations of redundant information. However, Broadbent's theory was meant to apply to unrelated, nonredundant messages originating from two or more auditory sources. Further research is needed before the applicability of the theory can be extended to multichannel presentations of related and redundant information.

Reviews of research have concluded that significant differences in modal performance of analogous auditory and visual tasks are prevalent in modality research (Henmon, 1912; Day and Beach, 1950; McGeoch and Irion, 1952; and Witty and Sizemore, 1958, 1959a, 1959b). That is, a group preference for one mode over another on a particular task can be demonstrated. Similarly, individual differences

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in modal preference have also been found. In examining previous research comparing bimodal and monomodal presentations, one is struck by the fact that none of the experiments is designed so as to consider the preferred mode of the individual.

The experiments are designed generally with three or more groups (one for each type of presentation), or with one group which receives all of the different modal inputs. After the tasks are given, the scores are derived for the presentations and subjected to some type of statistical treatment to test for significant differences. The conclusions are then drawn with no mention that the findings are generalizable only to group situations in which the whole group receives the same modal input.

Lockard and Sidowski (1961) compared the learning of nonsense syllables by fourth and sixth graders when presented auditorily and visually. In addition, a combined presentation (auditory+visual) was employed. The visual and auditory+visual presentations produced significantly fewer numbers of errors than did the auditory alone. A significant proportion of the subjects also ranked the visual and auditory+visual stimulus presentations over the auditory.

Using a sample of college students, Van Modfrans & Travers (1964) attempted to determine 1) whether a bimodal presentation (auditory+visual) results in superior learning when compared with a monomodal presentation (auditory or visual); and 2) whether perceptual interference is caused by a combined stimulus, with speed of encounter as a variable. Lists composed of words, words with constraint, or nonsense syllables were presented using one of the three modal forms with rates of presentation ranging from 4 to 0.6 seconds. The subject was then required to write as many of the 16 items in a list as he could remember in a minute and a half. The visual and auditory+visual presentations resulted in greater learning of nonsense syllables when compared to the auditory form of stimulation. Perceptual interference stemming from the bimodal presentation was not clearly demonstrated.

In both investigations, the simultaneous use of more than one mode did not result in superior learning when compared with the perform-

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ance attained using the preferred monomodal presentation which, in both instances, was the visual one. As noted, perceptual interference was not shown to be a significant factor in information mediation involving modal combinations. If a combined presentation does not result in superior performance and if perceptual interference cannot be demonstrated, then is it possible that humans perform a "tuning out" process (similar to the one described by Deutsch, 1968) whereby they attend initially to the stimuli received in other forms and through other channels?

Jester and Travers (1966) found a combined presentation to be generally superior to either an auditory or visual presentation for comprehension of connected meaningful discourse. However, in a discussion of their findings they state:

The superiority of the audiovisual mode of presentation could easily be accounted for by individual differences in capability to handle one or the other mode of presentation. Assuming that some people are better able to comprehend material by one or the other modality, then it is quite likely that the individual's preferred mode of receiving information would be used in the audiovisual presentation. This would permit many to do better when they had such a choice than when no choice of sense modality were available (p. 301).

They offer as substantiation for this interpretation the fact that:

... some subjects tended to cover their ears or eyes during the high speed modality presentation. Following the experimental sessions, subjects were asked their reactions to receiving information at such high speeds. Most of the subjects expressed the opinion that it was confusing and that they had to pay particular attention in order to comprehend the material. In addition, subjects in the audiovisual group reported that they had to exert particular effort to "block" one channel so that the other could be used and understood (p. 30).

Their observations would indicate that simultaneous multichannel presentation of even totally redundant information may result in interference. So far, no research has been produced to demonstrate interference in this situation. Actually, the majority of the research has opposed the interference hypothesis, including the study by Jester and Travers (1966). However, the role of modal preference in

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the determination of the superior modal presentation was not considered in this research. Until researchers consider the optimum learning mode for each individual in their investigations, the question of the superiority of bimodal or monomodal presentations of verbal materials will remain unanswered.

Efficacy of various modal combinations for teaching grapheme-phoneme correspondence for whole words. Different combinations of sensory cues were compared by King and Muehl (1965) in teaching children to associate printed and spoken words of similar and dissimilar word groups. The authors divided 210 kindergarten children into 10 groups. Five of the groups were assigned a list of similar words and five were assigned a list of dissimilar words. Five different modal combinations were employed. All of the five combinations included printed words as cues. The other sensory cues included in the combinations were: 1) pictures; 2) spoken words; 3) pictures + spoken words; 4) spoken words + echoic responses; and 5) pictures + spoken words + echoic responses. One group learning each word list was assigned to each sensory combination.

Dissimilar words were significantly easier to learn than were similar words. The printed word+picture combination proved to be the most efficient form for presenting similar words and the least efficient for dissimilar words. Printed word+spoken word was the most efficient method of presenting dissimilar words and the least efficient for similar words. Apparently, the degree of word similarity is an important factor in the efficiency of modal combinations. Further research in this area might well prove rewarding. A topic which appears to be of particular interest was suggested by the authors themselves in a statement concerning the greater difficulty incurred in learning similar words: "It would be interesting to determine whether the visual or auditory dimension of similarity contributes most to the learning difficulty" (p. 168).

The determiner of modal preference. Russell (1923) referred to experience or usage as a possible determiner of modal preference. He found that fifth graders scored higher on comprehension checks with oral presentations, ninth graders preferred visual presentations, and seventh graders demonstrated no preference. He concluded that the

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seventh grade was a "transition period" and suggested that experience in reading was the major factor in producing this transition.

Shapiro (1966) expanded this concept by stating:

The child's first experience with language is through hearing it. All verbal information in the first years of life is presented aurally. When the child enters school the pattern does not drastically change, but visually presented language information is slowly introduced. The difference observed in this study may simply reflect a difference in the amount of experience each age group has had with written materials (p. 425).

A different viewpoint is held by Cooper and Gaeth (1967). They state their position in the following manner:

At some point in language development there ceases to be a functional distinction between modalities. The least that can be said for language is that it must provide for functional equivalence between modalities or it fails its purpose. The parameters which govern the effectiveness of one modality over the other have no meaning when applied to highly familiar material. Any differences between modalities would seem to be a function of tendencies engendered by habitual manners of usage as opposed to inherent qualities of materials or subject variables such as reading level (p. 44).

Here one observes that if the material is equally familiar in either the visual or oral form, preference is determined by habit.

Both habit and experience were discussed together under the heading of "individual differences" by Krawiec (1946) when he said:

It may be that whether visual or auditory presentation is superior for retention is a matter wholly of chance individual differences, i.e., that for some S's one is superior and for other S's the other, depending largely on past experience, habituation, and the like (p. 193).

Katz (1967) introduced the variable of familiarity into her comparison of modes of learning. Her purpose for this was to provide a means whereby she could determine whether innate ability or familiarity, i.e., experience, is the deciding factor in modal preference. Using disadvantaged Negro males from the second, fourth, and sixth grades, she presented each subject with four tests of discrimination: visual and auditory tests of English, and visual and auditory tests of

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Hebrew. She found that the smallest discrimination difference between the normal and retarded readers was with the unfamiliar Hebrew visual symbols and accepted this as evidence supporting the experiential factor. However, the difference between the groups on this unfamiliar task was still significant. This significance appeared to support the innate ability factor. Katz concluded that both variables play a substantial part in discrimination performance.

The question of whether innate ability, experience, or habit patterns constitute the determiner of modal preference is circular. For example, innate ability allows one to make the most of experience, which, in turn, is probably a deciding factor in the establishment of habit patterns. If one follows a pattern, experience with a particular mode is strengthened, again within the bounds of ability. Habit patterns cannot be established without experience; experience cannot be gained without ability; and ability cannot be measured except through signs of performance, *i.e.*, experience.

Another factor crucial to the determination of modal preference is sensory defects. A person who cannot see well is more dependent on listening as a means of sensory reception; the opposite would be true for someone with a significant hearing loss. But for someone without a sensory defect who has a strong modal preference, the determination of modal preference would be narrowed to one or more of the three factors discussed above.

Basic Conclusions and Weaknesses

The research in each area has contributed to the general knowledge of the reading process. The research also serves as a guide for further experimentation, not only as a point of departure, but also as an index of weaknesses to be overcome.

Intersensory transfer and reading achievement

The evidence suggests that it is highly probable that ability to associate intersensory stimuli is significantly related to ability to read. However, the research investigating the relationship of cross-modal transfer skill and intelligence has been conflicting. Birch and Belmont (1964, 1965) failed to control for the influence of intelligence in their studies, though concluding that intelligence and intermodal transfer ability were both independent predictors of ability to read. The findings of Ford (1967) opposed this conclusion. Evidence supporting Birch and Belmont was furnished by Sterritt and Rudnick (1966), Rudnick, *et al.* (1967), Muehl and Kremenak (1966), and Beery (1967). Kahn (1965) and Kahn and Birch (1968) found that word knowledge and intersensory transfer were still significantly correlated even with intelligence controlled, but that the comprehension and transfer coefficients tended to lose their significance. Similarly, Jones (1970) found that sight vocabulary and intersensory transfer were still significantly correlated with intelligence controlled, but that the comprehension and transfer coefficient was no longer significant.

In addition, the question of when intersensory integration is important to success in reading is still unanswered. Muehl and Kremenak (1966) found it to be a significant factor in grade one; Birch and Belmont (1965), in grades one and two; Kahn (1965) and Kahn and Birch (1968), in grades two through six for comprehension and three

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through six for word knowledge; Beery (1967), from ages 8 to 13; Rudnick, *et al.* (1967) and Jones (1970), in grade three; and Birch and Belmont (1964), Sterritt and Rudnick (1966), and Ford (1967), in grade four. This would indicate that intersensory transfer skill is significantly related to reading achievement in grades one through six. But Birch and Belmont (1965) stated that its importance declined significantly after grade two, and Rudnick, *et al.* (1967) concluded that its importance increased significantly from grade three to grade four.

The difference in findings as to the relationship of auditory-visual transfer to intelligence and reading may well be the result of design variations and test differences. For example, at least five different tests (the Birch and Belmont test and four variations of it) were employed to test auditory-visual integration in the studies discussed above. Differences in ceiling effect among the tests were very evident. Differences in intelligence tests could very easily account for the variation in findings relating intelligence and intersensory transfer. Some were group tests, some were individual; some required reading, others did not. Although the importance of intersensory transfer ability to reading achievement has been demonstrated, its relationship to intelligence, chronological age, and grade level is still not well defined.

Other important weaknesses of individual studies in this area that have been noted include the lack of control of visual clues during the presentation of auditory stimuli, possible variation in stimulus patterns due to human error, and unrepresentative samples.

Intersensory perceptual shifting and reading achievement

The research in this area of learning modalities is insufficient to allow for the drawing of conclusions. Three of the four studies did reveal a significant relationship between perceptual shifting and some aspect of reading achievement. However, more studies are needed before the relationship can be confirmed or its nature defined.

Variations in the design of the studies has been important enough to be considered. Raab, *et al.* (1960) and Katz and Deutsch (1963)

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employed extreme groups in their studies, while Hurd (1967) and Jones (1970) used random samples. The relationship, if one exists, between intersensory perceptual shifting and reading achievement might well prove to be in the "necessary but not sufficient" category. That is, the ability to effect intersensory shifts rapidly may be necessary for learning to read well but will not in itself determine the degree of reading achievement. If this type of relationship does exist, studies which employ extreme groups will be more likely to find a significant difference between good and poor readers with regard to intersensory perceptual shifting.

Some concern must be registered over the variation in presentation of the stimuli and the instruments used in the presentation. For example, Jones (1970) used only two stimuli—one visual and one auditory—while Raab, *et al.* (1960) used three—one visual and two auditory—and Katz and Deutsch (1963) used four—two visual and two auditory. The instrument used by Jones (1970) for the presentation of the stimuli also differed from the instruments used in the other three studies.

Modal preference and reading achievement

The summaries of previous research in the area of modal preference drew conclusions regarding the presentation of information through printed and oral channels under various conditions. These conclusions are pertinent for learning, in general, but not for learning to read. Eight studies were reviewed which dealt with modal preference as a factor in learning to read. Each of these studies also considered the preferences of individual children.

Of the eight studies, only one (Bursuk, 1971) firmly supported the theory that the modal preference of an individual should be considered in teaching him to read. One striking feature of this study is that both the method used to determine modal preference and the learning task were conceptual in nature. This seems to support Wepman's statement (1971) that if a preference exists it is "... more readily discernible at the higher meaningful level of conceptual and symbolic thought" (p. 6).

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This study also differed significantly from the others with regard to the sample. The subjects in the sample, even though considered as retarded readers, still read well enough to allow the experimenter to determine if they comprehended differentially with a visual or an auditory input. In other words, the reading ability of the subjects permitted the use of a test of modal preference and a learning task which were conceptually oriented.

Current approaches for teaching decoding skills which eliminate entirely the integral role of both visual and auditory modalities are difficult to find. Certainly none of the existing basal programs on the market can be labeled either as visual or auditory, though some may be said to stress the auditory mode or the visual mode more than others.

An additional problem in the consideration of modal preference is the identification of the preference. At least four of the eight studies revealed weaknesses in terms of the identification of modal preference. High on the list of priorities, then, should be the development of a modal preference test. Quite likely, such a test would need to consider the conceptual as well as the perceptual aspects of learning. A valid test of modal preference would also do much to strengthen the research in this area.

In at least one of the studies reviewed, the assumption was made that there was an equal number of children in a random sample that preferred either the auditory or the visual mode. Such an assumption would negate any of the findings of the experiment. This criticism is, in actuality, an extension of the criticism levied at the identification of the preference. The possibility exists that a subject in a sample might make the highest score in the group in one modality area and the lowest score in the group in the other modality area and still prefer or learn better through that mode which seemingly was his weakest. The problem, then, is one of insuring equivalence of the tasks in the various modal areas of the test. Simply showing that a learner has a significant discrepancy between two subtests of a test of modal preference when compared with other learners is not sufficient evidence to classify the learner as to his modal preference, unless the test has established validity.

Recommendations for Further Research

This section offers possible solutions to correct weaknesses noted in previous experiments and suggests additional ideas and problems for the researcher. Only weaknesses which are specific to the areas of modality research will be considered. Discussion of more common weaknesses, *e.g.* sampling errors, teacher variation, and methodological differences, may be found in almost any book concerned with research design and methodology.

Intersensory transfer and reading achievement

If mental age is to be considered as a factor in the relationship between intersensory transfer and reading achievement, care must be taken to insure that the intelligence test does not involve reading. A test which is as free from cultural bias as possible might also receive consideration in measuring mental age.

The researcher should ascertain before drawing conclusions—for that matter, before conducting the research—whether his test of intersensory transfer has sufficient upper and lower limits to cover the range of subjects in his sample. A pilot study is the safest means of determining such information.

The control of extraneous clues is absolutely essential if the test is actually to measure intersensory transfer. For example, if the subject observes the examiner as he produces the auditory stimuli, he may respond on the basis of visual cues rather than the auditory ones. Taping the auditory stimuli will assure the examiner that the subject is responding to the auditory stimuli.

In addition, the use of taped stimuli will provide consistency in task presentation for all subjects. Examiners are not perfect and slight variations in the temporal presentation of auditory patterns might well affect the reliability of the measurement.

Recommendations for Further Research

The subject must not be allowed to look at the visual-spatial patterns while the auditory-temporal patterns are being presented. If the test is being administered to an individual, the examiner may present the sheet on cards containing the visual patterns after each auditory presentation. In a group testing situation, the examiner may instruct the subjects to place the response sheet face down until the auditory stimulus is presented each time.

Intersensory perceptual shifting and reading achievement

Experiments involving intersensory perceptual shifting will probably require an apparatus for presenting stimuli and measuring reaction time. The ideal apparatus would be one which automatically presents the stimuli according to some prearranged program and records the response times. Such a machine would offer the advantage of consistency of presentation from subject to subject. Also, only one person would be needed to operate it instead of the usual two.

Regardless of the type of apparatus used, the experimenter must make certain that no stimuli other than those under investigation will serve as cues. Most relays that are found in machines of this type produce a soft click just prior to the onset of the stimulus. The subject can anticipate both the auditory and visual stimuli by listening for this click. If relays cannot be obtained that operate silently, the apparatus can be equipped with a headset.

If the examiner must initiate each stimulus, he should be careful to conceal his movements from the subject. Even muscle movements can be a cue. If the apparatus is designed so that the subject faces it, the arm and hand with which the examiner will control the stimuli should be screened from sight. In cases where the chronoscope is hand operated, a long cord will allow the timekeeper to be placed in an adjoining room with a glass partition.

Modal preference and reading achievement

Most of the research in this area has followed this pattern: 1) a test or series of tests was administered to determine the modal preference of each subject; 2) the subjects were then given differentiated instruction in decoding skills which seemed to stress one modality

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more than the others. These studies have produced no significant interactions between modal preference and method of instruction in learning to decode words.

Two plausible explanations exist for why a significant interaction has not been found. The first possibility is that the tests of modal preference don't really determine preference at all. The second is that both the visual and auditory modes are both so strongly involved in the reading process that learning to decode words without the inclusion of both modes borders on the impossible for a child who is not deaf or blind.

One would be hard pressed to locate a method of learning to read which limits the role of either the auditory or the visual mode to a significant degree. The same situation would hold for materials. Perhaps the greatest weakness of modal preference research, then, is the failure to admit that possibly there is no discrete *auditory approach* or *visual approach* to learning to decode printed words. The findings in the area of intersensory integration would seem to support the latter explanation.

This would seem to point to the need for more research in the conceptual domain of reading, particularly with regard to comprehension skills. Bursuk (1971) offers evidence that practice in comprehension of information received through the auditory channel will aid in the improvement of comprehension of information received through the visual channel. This relationship has been thought to exist for some time due to the significant correlations obtained between listening comprehension and reading comprehension and as reflected by reading specialists' insistence that teachers should read stories to children and check their comprehension afterward.

The researcher should make certain that the aspect of reading achievement which he uses as criterion, *e.g.*, word recognition or comprehension, is reflected in the test for modal preference. If comprehension is the element of reading achievement under consideration, then comprehension of auditory and visual inputs should be incorporated into the test for preference.

The extent of preference should be considered as well as the direc-

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tion of preference, especially when decoding skill is the measure of reading achievement. If either the visual or the auditory mode is strongly preferred to the other, the importance of the preference might lie in its effect on intersensory transfer skill rather than its relationship to a particular approach. Seemingly, the greater the degree of preference, the more likely intersensory integration would be affected.

In the research concerned with bimodal versus monomodal presentations, the weakness that is most apparent is the failure to consider the individual preference of each subject. A fairly simple solution seems to be to divide the subjects into preference groups on the basis of their performance on the listening and reading tests. Those subjects who perform better on the listening test would be labeled as preferring the auditory mode and those who do better on the reading comprehension test would be categorized as preferring visual input of information. Subjects who demonstrate no preference would be labeled accordingly. Then all subjects could be administered the bimodal presentation. The mean bimodal score of each group could then be compared with the mean score of that group's preferred mode. The answer to the question of whether a bimodal presentation is superior to a monomodal presentation in the acquirement of information would, then, seem to have more validity. Perhaps, too, the applicability of cue summation to bimodal presentations would be answered.

Additional comments and recommendations

Little has been said in this paper concerning the kinesthetic and tactile (haptic) modes in learning to read. The Fernald technique has been shown to be quite successful in teaching retarded readers (Fernald, 1945). Children who learn to read through this approach after conventional methods have failed may not necessarily prefer the kinesthetic or tactile mode to the visual and/or auditory modes. Ofman and Shaevitz (1963) argued convincingly from their research findings that the important variable in the Fernald technique is the forced visual attention required in tracing—not the kinesthetic and tactile clues. Their conclusion opens an interesting area for research.

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The lack of longitudinal studies of the development of intersensory transfer, intersensory perceptual shifting, and modal preference in individuals has restricted the study of the relationships of these three variables to reading achievement more than any other factor. Researchers interested in this area should consider long range experimentation which emphasizes the developmental nature of these variables and their relation to reading. Questions such as the following must be raised and answered: Can intersensory transfer skill be increased at a rapid rate? Would such an increase result in significant reading gains? Do gains in intersensory transfer precede, accompany, or follow gains in reading?

Relationships existing among intersensory transfer, intersensory perceptual shifting, and modal preference should also be investigated. Would increases in either intersensory transfer or intersensory perceptual shifting or both be accompanied by or accompany the disappearance of a strong preference for a particular mode? Are intersensory transfer and intersensory perceptual shifting significant variables in the study of performance on bimodal versus monomodal learning tasks? Is intersensory perceptual shifting a key factor in proving or disproving Broadbent's (1958) Filter Theory? Questions such as these are important to learning theory as well as reading and should provide direction for future research in this area.

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